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(Ager Romanorum), stretching away to Veyran Shekr (Septimia Colonia), 10 hours off, before it ; its great natural and artificial strength agree better with the description of the old Rhaddium than any other ancient site—and I have seen, I think, all of them—in the whole range of mountain between this and the Tigris. The only other site that can be identified with it is that of Hatem Tai Castle (I conjectured in my memoir on the sources of the Tigris to be Sisauronon), close to Jezireh, but for strength and importance it cannot compare with Rubbut, nor is there a plain in its vicinity, it being built in a mountain gorge, and not perceptible till you come directly upon it. From here we returned to Diarbekr over the Metina mountain, visiting on our road the old convent of Deir Metina.* It is rapidly falling into ruin, no one lives there, and the only objects of interest are two fine marble sarcophagi—rifled long ago—in the quaint old chapel. It took us five hours from Rubbut to the other side of the range, and from there, passing Kurr i Giaour, Khurbey Kurro, Kuchuk Veyran, Orta Veyran, and Bir Bazin villages, we reached Meyrkesh—noted before—in four hours and a half, and Diarbekr in another three and a half.

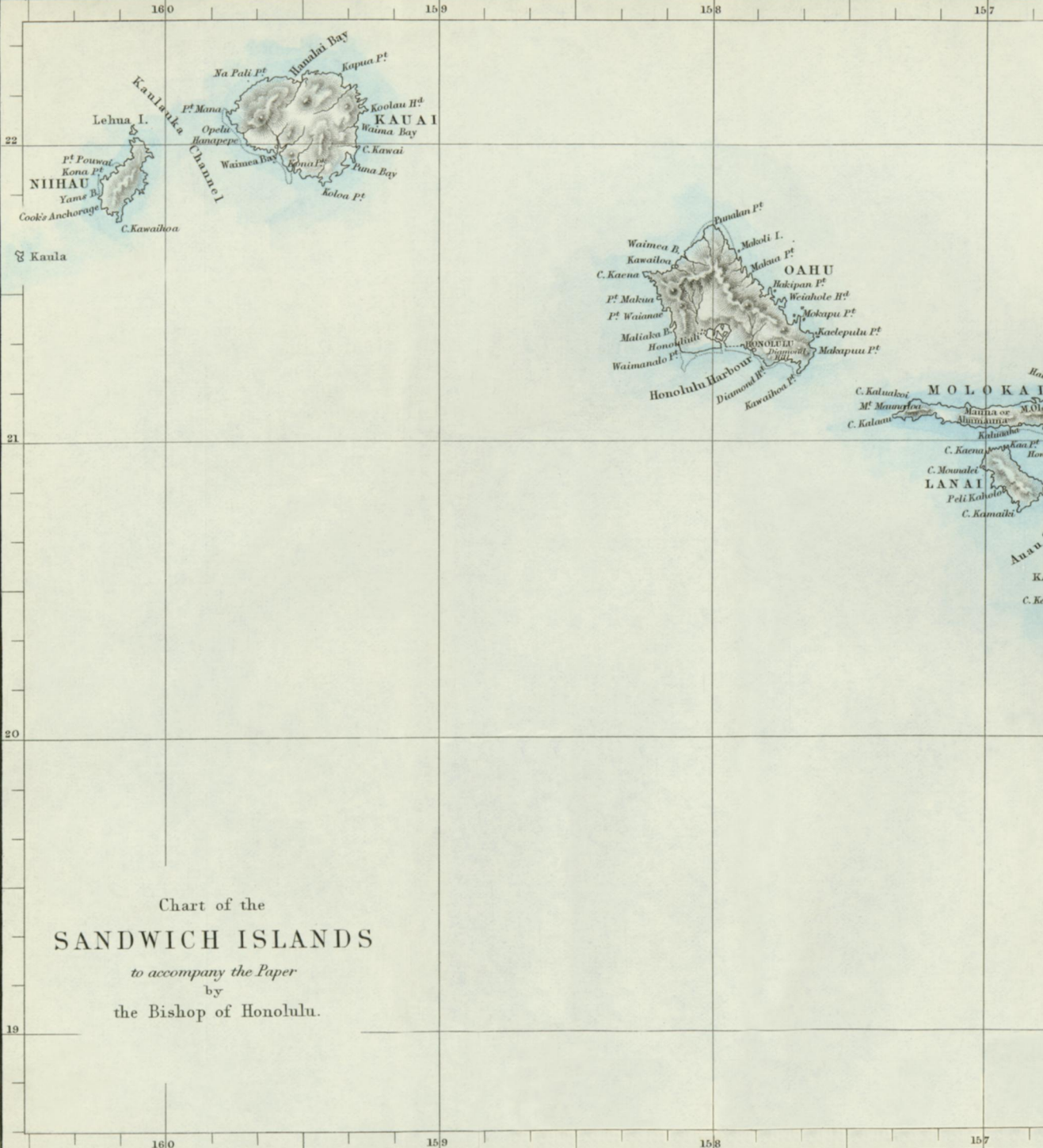
XII.—*On the Geography and Recent Volcanic Eruption of the Sandwich Islands.* By the Right Rev. THOMAS STALEY, D.D., Bishop of Honolulu.

Read, June 22, 1868.

BEFORE speaking of the late volcanic eruption in the Island of Hawaii, a few words may be useful on the geography of the group generally, of which it is the largest and the youngest member.

The Sandwich Islands, now constituting the kingdom of Hawaii, occupy a most central position in the Pacific. They lie in a diagonal direction from S.E. to N.W., between $18^{\circ} 50'$ and $22^{\circ} 20'$ N. lat. (so that they are only just within the northern limit of the Tropics), and between $154^{\circ} 40'$ and $160^{\circ} 40'$ of W. long. As affording a place of call for ships, merchantmen, whalers, and national vessels, they have been evidently marked out by their situation to have a commercial and political importance beyond that of the island groups in Central Oceania. Their total area is upwards of 6000 square miles. Beginning with the most westerly, Niihau, about 15 miles long, and 1 to 3 in varying width, taking a north-easterly direction, we come to Kauai. These two have an area of 550 square miles. Crossing

* Called also Kara Killiseea.



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Chart of the
SANDWICH ISLANDS
to accompany the Paper
by
the Bishop of Honolulu.

then a channel, which between the nearest points of land on either side is 80 miles in width, the next in order is Oahu, on which is the capital city of Honolulu, the chief port of the kingdom. Its area is 530 square miles. The others occur at less intervals, viz., Molokai, Lanai, Maui, with its islet of Kahului. These four may be put down as having an estimated superficies of 800 square miles. About 4000 will be found to represent that of the largest island, viz., Hawaii. The harbour of Honolulu is formed by a coral reef acting as a natural breakwater: a passage is marked out by buoys, and through it the vessels drawing above 20 feet can now enter. When the American Pacific Steamship Company, in 1866, proposed to run a line of steamers monthly between San Francisco and Yokohama (Japan), they sent an agent to Honolulu, on whose representation the Government deepened the harbour and extended their wharf seawards, so that these large vessels of between 2000 and 3000 tons might coal at its side. When all had been accomplished, the Company thought that the deflection from a great circle course, and then having to beat up in a higher latitude against the there prevalent west wind (a sort of return trade), would cause a loss of time, and they wished to cross in 18 days. In no instance, however, since the line commenced running has the voyage been accomplished in less than from 20 to 30 days. The fact is, they are finding the distance too great to carry the enormous quantity of coal necessary for the voyage: and so that, after all, by touching at the Hawaiian Islands, they would make a quicker and more certain passage, and, from a larger space being available for freights, one more profitable. While speaking of the geographical position of Honolulu, and its effects on the commercial prosperity of the islands, I may state that, within two years at the most, the railway between New York and San Francisco will be completed. The journey from Liverpool to Japan would then be distributed as follows:—

To New York	12 days.
San Francisco	7 „
Honolulu	8½ „
Yokohama	13½ „
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An addition to this of 8 days would extend the voyage to Hong Kong, the whole then being done under 50 days.

How far England has been wise as regards her interests in neglecting the often suggested plan of carrying the trunk line of railway from Canada through British Columbia to the coast, instead of allowing the connexion between the east and west seaboards of North America both by rail and telegraph to be the work

and the monopoly of our energetic cousin there, it is not for me to decide. I will only say that when the distance between New York and San Francisco is accomplished in 7 days (instead of in 23, as now it is over Panama), the present overland route to China by Suez will find it hard to compete, so far as passenger traffic goes, with the more rapid, healthier, and pleasanter route over the North American continent.

Happily for the social and moral improvement of the Hawaiians, the whaling trade has fallen off. In 1867 there were only 90 whalers in the autumn at Honolulu. The other vessels entering were: national or men-of-war, 9,—of which 5 were British, 2 American, 1 Russian, 1 French; merchantmen 109,—of which 54 were American, 24 British, 29 Hawaiian, 2 under other flags. To supply the wants of those ships, no less than of the native and foreign inhabitants, imports are required. Those in 1867 amounted in value to 1,835,808 dollars, nearly 2,000,000 dollars.

Climate and Productions.—Honolulu is under the isothermal line of 77° Fahr., the annual range of the thermometer being only 12°. At other places (according to aspect and elevation, of course) the temperature is very different. At Waimea, Hawaii, in the month of July (on a table-land 4000 feet above the sea-level), I have been very glad to have a fire in the room where I slept. Here the average reading is 64°, with a maximum range of 32°. Perhaps nowhere, with the same extent of coastline and surface, are the local climates so various. Though in the tropics, really there is no tropical wet season; the heaviest rains falling at the winter and not at the summer solstice, as they do in India, for example.

It is *then* the north-east trades—which prevail for 9 months of the year, depositing the vapours of the ocean on the northern and eastern slopes of the islands in gentle fertilizing showers—for a while cease, while southern winds take their place, bringing heavy rain and storms known by the name of konas. It is the eastern trade wind to which we refer when we speak of the windward or leeward side of the islands, and sailing to windward from one island to another. On the whole, the climate is most favourable to vegetation. The soil, volcanic in its origin, is generally fertile. The grass, now very prevalent, though not an indigenous one, is that called *Menenia*, running along the surface, striking roots everywhere on its course into the ground, and forming a most nutritious food for sheep and cattle. There are many cattle “ranches” (as they are there termed) and sheep-farms, in the hands of emigrants chiefly from New Zealand, Australia, British Columbia, and California.

For instance, Niihau is owned by a Scotch family, who came from Canterbury Settlement, and is used by them solely as a

sheep-run. Last year were exported in lbs. of wool nearly half a million, and of hides 304,095. It is pleasant in travelling up and down the island to meet everywhere with one's own countrymen, engaged in these pastoral and other useful pursuits, tending to develop the industry of the kingdom.

To pass over the indigenous *Fauna*,—which is so small as scarcely to deserve notice,—we have of woods, the *Kou* and *Koa*, heavy, hard, and handsomely grained; of *Sandal* wood there is now but a very scanty supply; the *Kukui* is a very common tree, bearing nuts, full of oil, which strung together once furnished the natives (and do still in the more remote parts of the islands) with the means of lighting their dwellings. There is, in fact, no other word in the language now for lamp but *Kukui*. The native food is the *Kalo*, or *Arum esculentum*,—a large succulent root, from whose meal a thick paste called *poi* is made, which when slightly fermented is usually eaten with salt-fish as a relish.

A native cloth has long been manufactured from the bark of the *Morus papyrifera*, or *Uauki* plant, as the natives call it. The plants found in the tropics generally are all easily raised in the Hawaiian Archipelago; while on the high tablelands wheat, Irish potatoes, and the products, both fruits and cereals, of the temperate regions are cultivated with success. Of rice, in 1867, were exported nearly a million of pounds. Coffee is not much cultivated, having had to sustain severe blights; but the increase in the sugar cultivation during the last few years has been remarkable: plantations, with mills for grinding the sugar and all the best and newest appliances sent from England and the United States, are to be found scattered everywhere throughout the kingdom. The export last year was 17,127,187 lbs. It is now about 1000 tons per month. This important element in the industry and material prosperity of the islands, present and future, is in the hands mainly of American, German, and British settlers. The labourers are the natives, and about 1000 Chinese coolies imported by the Government. Generally, the planters prefer the former; but the Hawaiian population is too small, without calling in the aid of the latter, adequately to supply the labour market. In a cursory glance, such as this, at the physical condition of these islands in relation to the industry and pursuits of their inhabitants, perhaps this is the proper place to say a few words on their social condition and political status. The last census, taken in 1867, shows a decrease of the native population of 8300 (or of 11 per cent.) in seven years, and increase of white foreigners of 400 (or of 15 per cent.) in the same period: the total population being 58,765 natives and 4194 foreigners. Into the causes of this

fearful decimation of the native people I will not here enter, further than to record my own conviction that though at the period of their discovery by Cook in 1778 the population was even then numerically on the wane, their diminution has been accelerated by their contact with the habits and, I grieve to say, the licentiousness, of many of our own race who have frequented their shores. During the last few years, the Hawaiian Government has, by liberal capitation grants and suitable regulations, sought to encourage everywhere the formation of Industrial Girls' boarding-schools, in which those of a class most likely to influence for good the next generation may be trained, from a very early age, to a higher appreciation of the dignity of the sex, and to become better wives and mothers than the land has hitherto possessed. The effect has been greatly to multiply such institutions, and they may be expected to have the most salutary results. An excellent Act was passed in the last legislature to regulate "the carrying of passengers between the islands," which prevents "any female under twenty-five years of age being conveyed to any port of the island without a passport from the magistrate of the district where she lives." Under the influence of these and other such remedial measures which the present King's paternal rule has initiated, we may yet reasonably hope to mitigate the evil. I may state that the legislative assembly consists of deputies elected on a property or *industrial* qualification, sitting in the same chamber with his nobles, making a total of 60 members. If he has no children, he may adopt his successor, subject to the approval of his chiefs. The judicial power is vested in a Supreme Court, and several Courts subordinate to its jurisdiction. The kingdom is divided into circuits, and each of these into districts for the administration of justice, with a circuit or district judge over each. The executive is in the King, who has a Cabinet of four Ministers, all foreigners. There is a system of common native schools, at which all children are compelled to attend; not to do so entails punishment on their parents or guardians. At these reading and writing, and so much of arithmetic and other elementary subjects as can be acquired through the native tongue, are taught. English, the study of which is an indication of advancement not only intellectually but morally, has, during the last six years, received a great degree of attention in the schools. From 733 scholars, in 1862, wholly taught in English, the number has now increased to 1000. On the whole, the social elevation of the people, and their preservation even yet from national extinction, are regarded as hopeful. There are well-made roads and an efficient system of police throughout the kingdom. Life and property are as secure as in any civilised

country in the world. I should state that the revenue last year, chiefly raised by 10 per cent. *ad valorem* duties on imports, was 220,000 dollars. Not only are these matters *not* foreign to the physical geography of Hawaii, they are intimately connected with it—setting aside transcendental relations—as the effects to the cause. I may add, they are almost needful to be known before we can understand the accounts which have reached us of the incidents in the late volcanic eruptions. The whole Hawaiian archipelago has been uplifted from the ocean by volcanic agency. Indications are not wanting that the same process is still silently and imperceptibly adding to the elevation of the coastline throughout the group. The facts on which such a view is grounded are not in my possession; but they furnished, a few years ago, the subject of a very interesting paper in a local journal, contributed by an English gentleman resident at Honolulu, who has the reputation of being a thoughtful and able geologist. It would seem that the emergence of some portions of the islands has been exceedingly rapid. In the island of Molokai well-defined coral is found at the height of 500 feet above the sea-level. A bed of coral, or coral-sand, exists on an elevation in Kauai 4000 feet above the sea-level.

Kauai, with its islets, is far the oldest of the islands. Its volcanic mounds and craters have been rounded off, so to say, in the course of ages into gently undulating hills. The scenery is soft and beautiful. It is a perfect garden in appearance, and most fertile. Still there are some craters and palis to be found in it of great antiquity. The valley of Hanapepe, at the head of which is a beautiful waterfall, has apparently been formed by volcanic action. The basaltic rocks and strata over which it falls have been much reversed and upturned, and present their columnar structure very distinctly to view, inclining to opposite directions at a vertical angle of about 30°.

Proceeding 80 miles eastwards we come to the central group, which, though with no active volcanoes at work, are of a later origin. No severe or destructive earthquakes are experienced in these islands, but only very slight vibrations. I except the submarine shocks, which, as in December, 1860, caused a rise in the harbour of Kahului 8 or 10 feet above its usual high-water level, spreading over the beach and destroying several houses. The chief extinct craters in these islands are in Oahu, Punch-bowl Hill, on which the fort at Honolulu is built—a comparatively small one—and Diamond Head, a few miles east of the same city. It is a promontory, on the top of which is a deep concavity. But it is at Maui we find the largest crater known, I believe, in the world. It is 10,000 feet high, between 20 to 30 miles in the linear measure of its rim, and more than 2000 feet deep. It

forms the umbilicus, so to say, of East Maui, which is one vast mountain, culminating in this crater; the sides rich in verdure and all kinds of vegetation. It will be seen the island of which I speak consists of two well-defined portions, connected by a sandy alluvial neck or isthmus, the lowest part of which is only 7 feet above the sea. The sand is constantly shifting, and as you pass in a vessel on the leeward side you may see clouds of it blown out to sea under the action of the trade-wind. The rock of the cliffs on the east of West Maui, which it terminates sharply, is basaltic. Anything grander or more awful than the view into that deep crater of Hale o ka la, as it is termed, cannot be imagined. It has, however, been so well and so often described, that I will not dwell on it now, but rather hasten to speak of that island which is the scene of modern volcanic action, where it has so recently been displayed with a frightful result to life and property. It would appear that the retreating of active volcanic influence from north-west to south-east, which has been stated to apply to the whole of the group, does so equally to the Island of Hawaii itself. In the north of the island are the heights of Kohala and Mauna Kea (13,000), the last covered with perpetual snow, skirting the grassy and fertile plain of Waimea. Here are craters never active within the period of the traditions of the people. In fact, a line passing through Mauna Kea from west to east would nearly define the parts to the north and south of it, *now* respectively exempt from, and exposed to, flows of lava, and even to destructive earthquakes. Running then parallel with the coast on the west is Hualalai, the last eruption of which was in 1800 A.D., when the stream of lava filled up a bay 20 miles long, and formed a headland running three or four miles into the ocean.

Mauna Loa, or, as it implies, *the great* Mountain, 13,500 feet above the level of the ocean, is to the south-east of Hualalai. On its eastern flank, about 30 miles from the coast, and on a plain 6000 feet above the sea, is the *pit crater* of Kilauea, a drawing of which was shown when this paper was read. Here was supposed to be the dwelling of the terrible goddess Pele, whom the converted chiefess Rapiolani, with a true Christian courage, defied in the presence of assembled multitudes, in the year 1825, by descending into the crater and casting the sacred berries into the seething lava. Its outer rim is about *nine* miles in circumference. You descend some hundreds of feet down a zigzag path cut in the precipitous sides of the pit till you come upon a black ledge. Passing banks of sulphur, and huge blocks of basaltic rocks confusedly heaped together, occasionally springing over crevasses of unknown depth, and

walking over every form of lava, still warm to the feet, you come to the part which is always more or less active. When I saw it the diameter was quite 500 yards; but its area sensibly alters. The depth and immense size of the pit may be expected to keep the lava from overflowing the country, as hitherto, at least in the period of history, seems to have been the case. Between 1856 and 1859 there were subterranean flows, which, after some time, came to the surface 20 miles to the north-east. But usually this volcano is not mischievous. In 1859 an eruption of Mauna Loa took place, passing round the northern end of Hualalai, destroying a village in its course, and projecting a coast-line some distance seawards. The whole country for some miles round this mountain is, if I may so say, one great field of cinders.

I can speak from experience that the ride from Kealekekua Bay, through this lava country to the volcano of Kilauea, and thence to Hilo, during its greater portion at least, is the most trying and painful possible. But from the central table-land on which stand these huge volcanic masses, all round to the coast, the country is fertile, dotted with villages, cattle ranches, and sugar plantations. But over the southern slope now, alas! has swept the most frightful devastation.

On March the 27th, a visitor to the Kilauea observed that the fiery lake had overflowed its usual limits, filling that part of the pit crater with an immense covering of lava. On the same day a column of smoke was seen to rise to an immense height from the summit of the mountain. The next day began a series of earthquakes, not apparently destructive until the 2nd of April, when the most terrific shock of all took place. In the interval one of the English clergy, with his diary and watch at his side, took notes of the direction, violence, number, and time, of each oscillation; whether vertical or horizontal, whether prolonged or instantaneous. His observations are most interesting, and I trust may serve in some way the purposes of science. Upwards of 300 earthquakes were registered by him; some, however, occurring in the short intervals of sleep, and consequently unheeded.

It was the earthquake of the fifth day, April the 2nd, which was so disastrous. Its destructive force was felt most at Kapapala, south-west of the mountain. The land all round a cattle ranch situated here was subjected to a severe mud eruption, burying hundreds of cattle beneath it. A tidal wave the same day for 50 miles north of Alualu rushed inland, destroying several villages and many lives. Stone buildings were hurled down, sometimes burying people in the ruins; not only in the

south, for houses were thrown down in Kona and Hilo. The settlement at Waiohino was utterly destroyed, thirty-three people perishing through the earthquake or tidal wave.

On the 7th of April, ten days after the first symptoms of the convulsion, a new crater opened on the flank of Mauna Loa, whence a stream of lava flowed into the sea half-way between Apua and the southern point, the mud-flow meanwhile wending its course to the north of this direction. One of the fairest parts of the island was thus in a single day converted into a black-looking desolate tract of cinders and lava. In many places in Kau the ground has opened, chasms of unknown depth have formed, whence sulphurous exhalations are emitted: a fissure, some miles in length, has extended inland from the coast, crossing one of the island high roads, and so deflecting it that what were contrary sides before are, at the point of breakage, now in one and the same straight line.

The floor of the crater in the Kilauea volcano has sunk some hundreds of feet. At Lahaina, 120 miles from the starting point of the eruption, the column of cloud ascending from it was observed under an angle of $3^{\circ} 30'$, which (allowing for 500 feet of altitude, the position of the observer) indicates a height of nearly eight miles. So vast a body of vapour rushing visibly upwards with tremendous rapidity showed an immense heat at its base. The great rarefaction by heat of the air near the new crater would cause a powerful upward draught; then the cold air charged with the vapours of the surrounding sea would rush in to take their place. Rapidly ascending, vast quantities of water would be precipitated in the form of cloud, and, when cooled, sink and be borne westwards by the trade-winds. This exactly happened; for, days after the eruption, the leeward islands were enveloped not only in a close oppressive atmosphere, but in clouds and heavy rains. A very distinct odour of sulphurous acid was perceptible at Honolulu, 200 miles distant, two days after the eruption.

The facts that I have grouped together connected with the recent catastrophe may serve possibly the purpose of those who investigate the laws, if there be such, which regulate volcanic agency.
